

2015

Extreme Light Infrastructure
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ELines



Professor Dr. Wolfgang Sandner (1949-2015)



On Saturday December 5th, Professor Dr. Wolfgang Sandner sadly, and very unexpectedly passed away at the age of 66. The laser and optics community, he worked so much to shape over the years, had just lost his flag captain. The week before we were all together at the International Conference on Extreme Light (ICEL 2015) in Bucharest. When the news struck us, we felt invaded by a tremendous sense of nothingness.

Wolfgang Sandner's personality combined a highly skilled scientist, an architect, a fine

politician and an accomplished diplomat with a knack of unification and organization of science. Over the years his influence in the field of laser physics grew to become global.

Following his return from the University of Tennessee in 1993, Wolfgang Sandner was one of Max Born Institute's directors for ten years. In 2001, under the leadership of the OECD, he contributed to founding a IUPAP¹ working group called ICUIL², to structure the scientific community around the field of ultra-intense lasers and their applications. He was its vice-chair for the past 4 years. Wolfgang's proficiency was sought by many scientific organizations and scientific boards. His expertise reached the governmental level, where he impacted the definition of the German and European science policies.

In 2003 he managed to weave an extended network called Laserlab-Europe formed by the major laser laboratories in the EU. Laserlab-Europe has been a resounding success that continues to grow today and clearly contributed to the European leading role in optics in the world.

¹ International Union for Pure and Applied Physics.

² International Committee for Ultrahigh Intensity Lasers.

³ European Strategy Forum on Research Infrastructures

Building the highest intensity laser: the birth of Extreme Light Infrastructure (ELI)

After one of us (G.M.) proposed in 2005 the construction of the first ultrahigh intensity laser infrastructure, ELI, Wolfgang Sandner was immediately a strong supporter of this initiative. Only one year after, in 2006, ELI joined the ESFRI³ roadmap. Later the decision was made to build a distributed research infrastructure based on 4 pillars, each specialized in a different emerging field of the extreme light research: Secondary Beam Generation and Applications in Czech Republic (Dolní Břežany), Nuclear Physics in Romania (Măgurele) and Attosecond Physics in Hungary (Szeged), thus giving priority to the first 3 pillars. At the cost of almost 1B€, this distributed infrastructure will be unique in many respects. Wolfgang Sandner's role was invaluable in convincing EU policy makers to permit use of Structural Funds, previously reserved for civilian infrastructures, to build ELI. In 2010 the ELI Preparatory Phase was completed and, shortly after, mandate was given to Czech Republic, Romania and Hungary to implement the 3 pillars. Later, the coordination task was handed-in to the ELI Delivery Consortium (ELI-DC AISBL).

In 2013, owing to his recognized scientific aptness combined with his seasoned experience and incomparable managerial skills, Wolfgang Sandner was selected the Director General of ELI-DC, in charge of coordinating the parallel implementations and the transition towards operation of the the world's largest, civilian laser research facility for users.

Wolfgang Sandner has significantly contributed to bring Europe arguably at the top spot in the field of laser research and applications. Beyond that, we will remember him as the one who taught us that science is a unifying element that is possible to endeavor with serenity all together and to the benefit of all.

In this sad moment, the determination is higher than ever, and no effort will be spared to create the necessary conditions for ELI to succeed in the European constellation of research infrastructures, thus transforming Wolfgang's dream into reality.

Catalin Miron, Gérard Mourou, Toshiki Tajima

Introducing ELInes

Only ten years after the original spark-idea the implementation of the Extreme Light Infrastructure (ELI) is now close to completion. After 2018, the distributed laser facility will attract the brightest European and international users. Eventually, its operation will be undertaken under the unified governance of a European Research Infrastructure Consortium, **ELI-ERIC**. At the moment, the Extreme Light Infrastructure Delivery Consortium International Association (**ELI-DC AISBL**) is coordinating the transition between the implementation and the operation phase of ELI. Recently, ELI-DC has launched a new website. We encourage you to take a look at it [here](#).

ELI-FAMILY

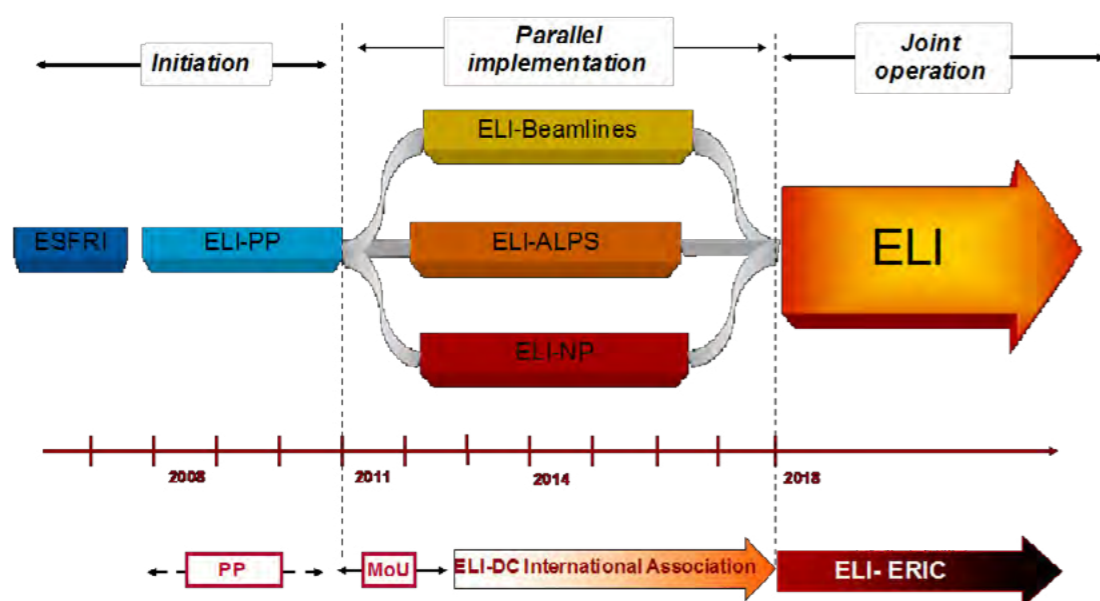
The very nature of ELI, distributed over three (later four) research centers in Czech Republic, Hungary and Romania, implies a considerable joint effort of hundreds of highly-professional and highly-dedicated scientists, engineers, as well as technical and administrative support staff. Luckily, ELI has also been surrounded and supported from the very beginning of the implementation by a faithful, international tissue of high-level professionals from academia, research institutions and industry.

They all together form the "ELI-family": and it is thanks to them and to their immense sense of duty that ELI is now in the process to be declared by the European Strategy Forum on Research Infrastructures (**ESFRI**) one of its landmarks, for its role as reference project of scientific excellence and of competitiveness of the European Research Area (**ERA**).

It is to connect all of these hundreds of contributors that we are now launching ELInes, an electronic newsletter with quarterly appearance which periodically informs the whole ELI-family about the progress in the implementation, about the transition between the implementation phase and the operation phase of ELI as an international laser facility for users, about the minor and major achievements at the ELI research centers, about scientific and technological highlights but also about the members of the family: you, the readers of ELInes. We count on your support to help us share with the whole family your projects and your achievements to make ELI-ERIC a great success for years to come, as Wolfgang Sandner dreamt.

We wish you an enjoyable reading experience!

Catalin Miron



The Road to ELI-ERIC

2015 may turn out to be a decisive year for ELI. The three pillars will, by the end of 2015, have formally completed the first phase of their ERDF funding scheme while already having entered into the next phase under the EU Financial Framework 2014-2020. Three major events have highlighted the impressive status of the projects: The JASPERS Networking Workshop in May, the ELI-Day in Rome in October, and the opening of the ELI Beamline facility on October 19th. At the same time ELI as a whole is preparing for the start of the operational phase in 2018. Operations will be governed by a new legal structure, ELI-ERIC, the preparations of which started with several parallel activities in 2015. Among those is the submission of the EC-funded, 3.4 Mio EURO ELITRANS project in January which commenced on September 1st. ELITRANS will develop in some detail all the necessary concepts for the future ELI-ERIC, including its legal, technical and operational basis. In parallel, representatives from all potential ERIC stakeholder countries will supervise the preparation of the ERIC application to the EC, foreseen for the end of 2016.

Summary

3.1 Implementation status of the pillars: the JASPERS Networking event

3.2 The ELITRANS project: overall goals and structure

3.3 Views from a member country

3.4 ELITRANS teams start working: kick-off work package 6 – Diagnostics

3.1 Implementation status of the pillars: The JASPERS Networking event



From left to right, M Lóránt Lehrner – Managing Director of ELI-ALPS, M Roman Hvězda – ELI Beamlines Project Manager, and Prof Nicolae-Victor Zamfir – ELI-NP Project Director.

During the period 2009-2014 the JASPERS (Joint Assistance to Support Projects in European Regions) network supported all the ELI pillars with technical assistance, with the aim of preparing project documentation in line with the European Commission's requirements for co-funding of major projects. JASPERS also assisted in a number of other areas, including issues related to state aid, environmental aspects and institutional management.

The close cooperation with the different stakeholders in ELI gave JASPERS a very good overview of the status of all the projects. The network concluded that despite the good progress made in implementation, on the different national levels there was a lack of overall understanding of the progress of the ELI pillars, as well as of the future roles

and responsibilities of the stakeholders in connection to national RDI strategies.

To discuss these and other topics between all the different parties involved, last May 5th and 6th a technical workshop was organized under the auspices of the JASPERS Networking platform.

Representatives from all the ELI Pillars, relevant national authorities and the European Commission participated as speakers and in the audience. Furthermore, representatives from some of the member states of ELI-DC were also invited as observers.

The workshop consisted of 4 different sessions over two days: *i. Status of ELI Pillars, ii. Role of national authorities in the ELI project, iii. ELI Delivery Consortium, and iv. European Commission (DG Regio and DG Research).*

SUCCESSFUL INITIATIVE

This workshop was both successful and very timely. In particular, the different national authorities appreciated meeting their counterparts in other ELI countries to exchange experiences, to get an understanding of where the ELI project stands and what the next steps are. The contribution of the Commission to the workshop was also very important to clarify procedures and requirements for possible EU funding of the second phases of the projects.

Finally, the outcome of the workshop also confirmed a strong interest among all the stakeholders to have similar events organized on a regular basis, and covering also on more targeted areas, like those mentioned above, on open access and integration of the ELIs with national R&D policies. While JASPERS would not necessarily take the lead for the organization of future events, it stands ready to support ELI-DC in this role. The next ELI-JASPERS event is tentatively planned for mid-2016.

The JASPERS Networking Platform was created to complement JASPERS project advisory operations by implementing knowledge sharing and capacity building activities, as well as fostering dissemination of good practices and exchange of experiences among all EU member states, pre-accession countries and other JASPERS Stakeholders. More information on JASPERS and the Networking platform is available at www.eib.org/jaspers or at www.jaspersnetwork.org



Wolfgang Sandner – Director General of ELI-DC AISBL.



Massimo Mara – Senior Officer at JASPERS Networking Platform.



3.2. The ELITRANS project: overall goals and structure

The scope of the EU funded ELITRANS project (1 September 2015 – 31 October 2018) is to complement the final implementation stage – parallel to the completion of the three construction sites – by preparing and undertaking the back-transformation from three legally independent construction projects towards governance, operation and financing under a single international legal entity, ELI-ERIC.

The 11 work packages, covering a wide range of administrative and scientific and technological issues, facilitate and enhance the actual work developed by the Delivery Consortium (ELI-DC) towards the fulfillment of this scope; mainly in the definition of the Statutes and Technical and Scientific Description of the future Research Infrastructure.

One of the first milestones was the ELITRANS kick-off meeting on October 19th, where all work package leaders and co-leaders met in order to set up a roadmap for the next 35 months, to reach the highest synergy among their work and complementarity to the working groups performing on operational cost, scientific and technical description and ERIC model definition.

Group picture of the participants at the ELITRANS kick-off meeting in Dolní Břežany (Czech Republic) on October 19th, 2015.



3.3. Views from a member country: the ELI-Day in Italy

Italy, which is amongst the founders of the ELI-Delivery Consortium (ELI-DC), has strong scientific interests both in the construction and in the use of ELI. The major Italian research institutions, as the National Research Council (CNR), the National Institute of Nuclear Physics (INFN) and Elettra Sincrotrone-Trieste (Elettra-ST), have considerable expertise in several technological areas that affect ELI, ranging from the field of accelerators and laser systems for high energy and ultrashort pulses to the implementation and management of large research facilities open to international users. The Italian contribution to ELI is also stimulating an effective collaboration among the research institutions, which will certainly contribute to reduce the fragmentation of the national research system.

On October 9th a symposium was held at CNR Headquarters in Rome in presence of the major Italian research and political authorities, with the aim of presenting the opportunities offered by the three ELI pillars to the Italian scientific community and to the industry representatives. A strong research community with multidisciplinary skills (atomic and

molecular physics, solid state physics, nuclear physics, radiobiology and radiotherapy) and interests specific to ELI participated in the symposium with more than 130 attendees. The contributions were focused on the main scientific missions of the three ELI pillars covering multiple areas such as: (i) Plasma dynamics and particle acceleration; (ii) Nuclear physics and ultra-high field applications; (iii) Short-wavelengths and ultrafast applications.

The successful meeting is a further stimulus for Italy to pursue the project of transformation of ELI-DC towards an ERIC, with the support of the scientific community and of the major authorities.

Claudio Scarpino, CNR Press office.



3.4. ELITRANS teams start working: kicking-off work package 6 – Diagnostics

ELITRANS project consists of two categories of activities, coordinated via two classes of work packages: those dealing with the organizational transition of ELI from the implementation to the operation phase, and those dealing with the key S&T coordination activities allowing to identify and implement synergies, and optimize the human and the financial resources of the ELI research centers in view of their future unified operation for users under the governance of ELI-ERIC. The latter include a work package (WP6) focused on the development of common strategies, methodologies, concepts and devices to characterize a standard set of parameters of the primary and the secondary sources made available to the users at the ELI research centers. The work package is coordinated by

Károly Osvey from ELI-ALPS and Ioan Dancus from ELI-NP.

The kick-off meeting of the Diagnostics work group has been organized as a two-day event held in the premises of ELI-ALPS in Szeged (Hungary). Representatives of all ELI pillars as well as ELI-DC took part in this meeting.

The first day the participants to the kick-off meeting had the possibility to visit the construction site of ELI-ALPS and to appreciate the amazing progress made with the construction and the equipment of the buildings, to be fully delivered in the second half of 2016. The second day was divided in several sessions allowing to structure the work and define a roadmap for the work group in accordance to the work plan. The future meeting dates, the distribution of tasks, as well as the workshops foreseen to support the work plan have been established. All participants enthusiastically agreed that this was a great kick for a very interesting and useful work for ELI and its future users.



Partnerships: the EUCALL project

ELI, as one of the Europe's key infrastructures in photon-science and applications, is involved in a number of pan-European partnerships which received funding from the European Commission within the Horizon 2020 framework, some of which even go beyond the boundaries of Europe, such as the CREMLIN project, aiming at establishing co-operation between the mega-science projects in the Russian Federation and the major European research infrastructures in physical sciences.

In the present issue, we would like to focus on one of these projects, called EUCALL, through an interview with the coordinator of this project, **Thomas Tschentscher** from the European XFEL in Hamburg. The project started on October 1st 2015 and will run until September 30th 2018.

What does EUCALL do?

'The European Cluster of Advanced Laser Light Sources (EUCALL) is a network between leading large-scale user facilities for free electron laser, synchrotron and optical laser radiation and their users. Under EUCALL, they work together on their common methodologies and research opportunities, and develop tools to sustain this interaction in the future. EUCALL has received funding from the European Union's Horizon 2020 research and innovation program and involves 11 partners from nine countries during the project period 2015 to 2018.'

Which partners are involved in the program?

'Three major international RIs have a key role in EUCALL: European XFEL, a 3.4 km-long X-ray free-electron laser that will open in 2017 and use ultra-bright X-ray laser flashes to investigate nanoscale particles, ultrafast processes, and extreme states of matter;



the Extreme Light Infrastructure (ELI), a trio of cutting-edge high-power optical-laser laboratories in the Czech Republic, Hungary, and Romania that will become operational in 2018; and the European Synchrotron Radiation Facility (ESRF) in Grenoble, France, which is one of the most prominent X-ray research centers in the world.

Also involved are five other institutes: DESY, which operates the FLASH and PETRA III X-ray user facilities, in Hamburg, Germany; Elettra, which operates the 2-stage seeded FERMI free-electron laser user facility, in Trieste, Italy; Helmholtz-Zentrum Dresden-Rossendorf, which operates high-power optical-laser facilities and a free-electron laser, in Germany; Lund University, which is building the MAX-IV synchrotron, in Sweden; and Paul Scherrer Institut, which is building the SwissFEL X-ray free-electron laser, in Villigen, Switzerland.'



The kick-off meeting of the EUCALL project took place in Hamburg, in the premises of CFEL, October 29th and 30th 2015. The participants also had the possibility to visit the construction site of European XFEL, including the impressive tunnel which will host the linear accelerator. More information about EUCALL can be found by following [this link](#).

What is innovative in EUCALL compared to previous collaborative projects involving research infrastructures?

‘Within the EUCALL project, the two types of large-scale X-ray RIs in Europe collaborate for the first time in a comprehensive way on technical, scientific, and strategic issues. One of the project’s main goals is to make substantial scientific and technological contributions through new synergies between laser-driven and accelerator-driven X-ray RIs. Under EUCALL, the RIs can work together on common methodologies and research opportunities, potentially sparking new scientific investigations, as well as new applications and private-sector innovation, and develop tools to sustain this interaction in the future. The project will allow the involved RIs to provide scientists from around the world better access to highly sought-out X-ray facilities.’

What will be the added value for the European Research Area?

‘EUCALL enables optical-laser- and accelerator-based X-ray facilities in Europe to develop common strategies and new technologies to help our scientific users engage in even more research possibilities.’

Implementation of these strategies and efforts will help European research maintain a leading role in many critical areas. EUCALL will achieve, in a three-year time frame, a very important contribution to the harmonization of the RI landscape in the ERA in general, and to the competitiveness and long-term relevance and sustainability of the advanced laser light source RIs in particular.’

How are ELI-DC and the three pillars of ELI involved and where will they contribute?

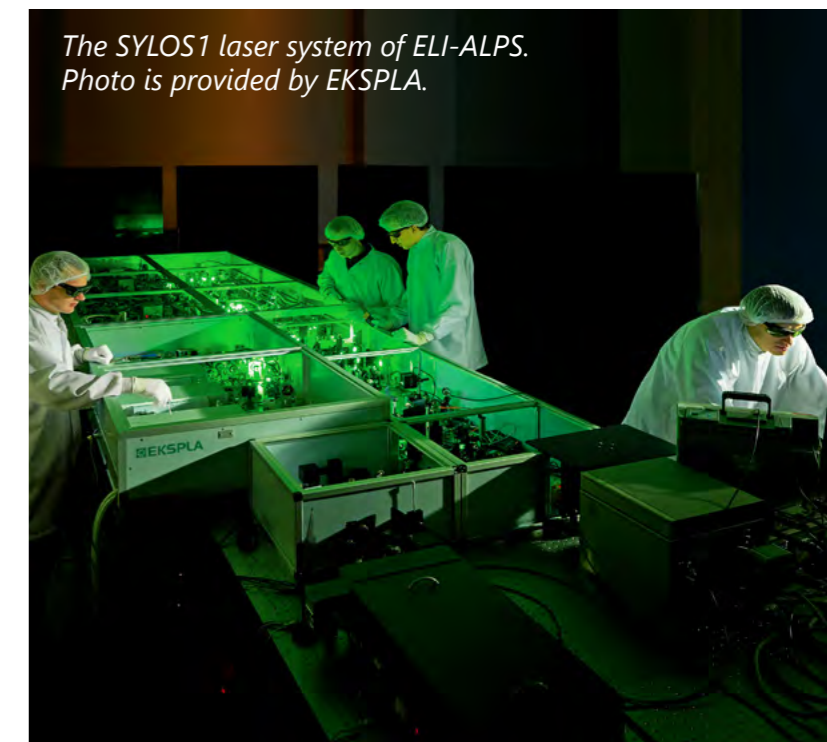
‘ELI is participating in EUCALL via the ELI-DC. A total of 15 ELI scientists from all of the ELI pillars are taking part in the technical work packages which involve: developing software and building new hardware for Simulation of Experiments, Ultrafast Data Acquisition, High Repetition Rate Sample Delivery, and Pulse Characterization and Control, while ELI leads one work package devoted to Synergy of Advanced Light Sources.’

Introducing



ELI Beamlines facility

The Czech Republic hosts the ELI Beamlines facility, which will contain high-power, high-repetition-rate lasers for high-field physics experiments with focused intensities of about 10^{23} W/cm². These types of lasers can be used to investigate exotic plasma physics and non-linear Quantum Electro Dynamic effects, for example for use in molecular, biomedical and material sciences, physics of dense plasmas, warm dense matter, and laboratory astrophysics. Follow the construction works [here](#).



The SYLOS1 laser system of ELI-ALPS. Photo is provided by EKSPLA.

ELI-ALPS, the facility for attosciences

The four laser systems of the ELI-ALPS facility in Hungary will deliver pulses with unique parameters: unparalleled fluxes, extreme broad bandwidths, and sub-cycle control of the generated fields. This exceptional performance will give way to a set of secondary sources with incomparable characteristics, including light sources ranging from the THz to the X-ray spectral ranges. These can be used for investigation of extremely fast dynamics by taking snapshots in the attosecond scale (a billionth of a billionth of second) of the electron dynamics in atoms, molecules, plasmas and solids. Look at a visualization of the building [here](#).



ELI-Nuclear Physics facility

Laser-based nuclear physics is the focus of the Romanian based ELI Nuclear Physics facility. It will host two machines, a dual-beam high intensity laser system, which will allow one to achieve intensities of the order of 10^{23} - 10^{24} W/cm², and a very bright, tunable gamma beam. Fundamental topics include nuclear physics experiments to characterize laser-target interaction, photonuclear reactions, and exotic nuclear physics and astrophysics, and applications of societal relevance in materials science, in the management of nuclear materials and in life sciences.

Research highlights



ELI BEAMLINES

ELISE: hydrogen "ice" for future laser-based proton therapy

The intense scientific and technological collaboration between a group

of scientists and engineers coming from ELI Beamlines (IoP-ASCR, Prague) and Service des Basses Températures (INAC-CEA, Grenoble) has led to the first worldwide experimental test of a cryogenic target delivering system made of a very thin solid hydrogen ribbon as a source of fast protons produced by high-power lasers.

'This is the first time ELISE has been tested with a high power laser and several technical challenges were uncovered during the experiment at PALS,' says Dr Andriy Velyhan from ELI Beamlines. 'We have produced an extremely high temperature gradient through the generation of a very hot (hundreds millions degrees) plasma and a hydrogen ice ribbon (-233 °C). Beside the potential for proton acceleration and future applications in hadron therapy, this result is also very interesting to the field of laser plasma physics and will certainly enable the scientific community to investigate new phenomena.'

[Read more](#)

ELI-ALPS

Advances in high-order harmonic generation sources

In a recent article in the *Journal of Electron Spectroscopy and Related Phenomena*, our researchers in collaboration with colleagues from Politecnico di Milano,

CNR-IFN and FORTH review the current status of high harmonic generation based attosecond dynamical studies, and possibilities offered by Free Electron Lasers. They explain the novel possibilities that will be offered by ELI-ALPS attosecond sources, improved with respect to the present systems in terms of repetition rate, photon energy or XUV intensity. Examples of dynamical studies enabled by the unique sources in the new infrastructure is also given.

ScienceDirect link to the article is found here. <http://www.sciencedirect.com/science/article/pii/S036820481500239X>

ELI-NP

Radioactive beams for a close look into atomic nuclei

A large international team of researchers, one of whom works at ELI-NP, recently published an article in *Physical Review Letters* on using very short-lived post-accelerated radioactive beams to populate excited states of the neutron-rich nuclei of a Rubidium isotope. The researchers reached ground-state excitation, far from stability, and recorded the spectra of the decay processes to gain insight in the deformation of atomic nuclei around the magic proton and neutron numbers.

Read the full article [here](#)

You are warmly encouraged to submit your suggestions for highlights to be published in the future issues of *ELInes* by writing to us at ELInes@eli-laser.eu.

EVENTS



ICEL 2015 One of the major ELI-events of the year was the **International Conference on Extreme Light 2015**, co-organized by [ELI-DC AISBL](#) and [ELI-NP](#), which took place in Bucharest, Romania, from the 23rd to the 27th of November 2015. Over 175 participants from 26 countries attended the conference, which covered a broad range of applications of the extreme light in various fields across natural sciences, from very fundamental (attophysics, plasma physics, nuclear physics and fundamental interactions,) to applied aspects (acceleration technologies, imaging, materials science, biological and medical applications). Both the Romanian Minister of Education and Research as well as the State Secretary for research were present for the Opening ceremony.

You can follow the the actuality of the events organized by ELI research centers or related to ELI, in the [Events section](#) of ELI-DC's website at: <https://eli-laser.eu/events/>



Colophon

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We would be happy to collect your comments and receive suggestions for new subjects to be treated by ELines. You can contact us via our website and at elines@eli-laser.eu

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